

ality of touch sensors physically coupled to the touch surface. Each of the touch sensors produces a sensor signal in response to a touch applied to the touch surface. A control system, coupled to the touch sensors, receives sensor signals and acquires a touch signal from the sensor signals corresponding to a touch on the touch screen, detects a first occurrence of a touch signal shape in the touch signal, and determines touch location using touch signal information obtained in response to detecting the touch signal shape. The touch screen display system further includes a display for displaying information through the touch screen.

[0013] Another embodiment of the invention is directed to a display system including a touch screen system, a display for displaying information, and a processor coupled to the touch screen and the display for processing data displayed on the display and information received from the touch screen control system.

[0014] In accordance with a further embodiment of the invention, a system includes means for acquiring a touch signal corresponding to a touch on the touch screen, means for detecting a first occurrence of a touch signal shape in the touch signal, and means for determining touch location using touch signal information obtained in response to detecting the touch signal shape.

[0015] A further approach of the invention is directed to a system including means for associating a touch signal shape with a level of touch signal error, means for acquiring a touch signal corresponding to a touch on the touch screen, means for detecting a first occurrence of the touch signal shape in the touch signal, and means for determining touch location using touch signal information obtained in response to detecting the touch signal shape.

[0016] Yet another embodiment of the invention involves a system providing means for acquiring a touch signal arising from a touch force on a touch screen, means for detecting a touch signal shape within an interval of the touch signal associated with maximum touch force, and means for determining touch location using touch signal information obtained in response to detecting the touch signal shape.

[0017] In accordance with another embodiment of the invention, a computer-readable medium configured with executable instructions for causing one or more computers to perform a method determining touch location on a touch screen, the method including acquiring a touch signal corresponding to a touch on the touch screen, detecting a first occurrence of a touch signal shape in the touch signal, and determining touch location using touch signal information obtained in response to detecting the touch signal shape.

[0018] The above summary of the present invention is not intended to describe each illustrated embodiment or every implementation of the present invention. The figures and the detailed description which follow more particularly exemplify these embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The invention may be more completely understood in consideration of the following detailed description of various embodiments of the invention in connection with the accompanying drawings, in which:

[0020] FIG. 1 schematically illustrates a top view of a touch screen with force sensors located at the corners of the touch screen in accordance with an embodiment of the invention;

[0021] FIG. 2 schematically illustrates a cross-section view of a capacitive force sensor in accordance with an embodiment of the invention;

[0022] FIG. 3 schematically illustrates a perspective view of a touch screen with force sensors located at the corners of the touch screen in accordance with an embodiment of the invention;

[0023] FIG. 4 illustrates the magnitude of force with respect to time of various touch types;

[0024] FIG. 5 is a block diagram of a touch screen and touch screen control system in accordance with an embodiment of the invention;

[0025] FIGS. 6A-6E are conceptual flowcharts illustrating various methods of determining touch location in accordance with embodiments of the invention;

[0026] FIG. 7 illustrates a touch signal threshold point and a touch signal location point for obtaining touch location information in accordance with an embodiment of the invention;

[0027] FIG. 8 is a flowchart of a method for determining a preferred time for touch location based on a predetermined value of a relative slope in accordance with an embodiment of the invention;

[0028] FIG. 9 is a flowchart of a method for determining a preferred time for touch location based on a change of sign of a relative slope in accordance with an embodiment of the invention;

[0029] FIG. 10 is a flowchart of a method of determining a preferred time for touch location based on a midpoint of a range of the touch signal corresponding to a predetermined value of a relative slope in accordance with an embodiment of the invention;

[0030] FIG. 11 is a flowchart of a method of determining a preferred time selected as a time following a predetermined delay following a touch signal value corresponding to a predetermined value of a relative slope in accordance with an embodiment of the invention;

[0031] FIG. 12 is a flowchart of a method of determining a preferred time for touch location measurement for a slow touch in accordance with an embodiment of the invention;

[0032] FIG. 13 is a flowchart of a method of inhibiting touch location values for a streaming touch when the relative slope is outside a predetermined range in accordance with an embodiment of the invention;

[0033] FIG. 14 is a flowchart of a method for determining touch location for a streaming touch in accordance with an embodiment of the invention;

[0034] FIG. 15 is a block diagram of a data processing system using a touch sensing interface in accordance with an embodiment of the invention;

[0035] FIG. 16 illustrates a touch screen controller in accordance with an embodiment of the invention; and

[0036] FIG. 17 illustrates signal alterations resulting from damping of touch surface motion.

[0037] The invention is amenable to various modifications and alternative forms. Specific embodiments of the inven-